

Appl. No. 10/698,988
Amdt. Dated February 13, 2006

Attorney Docket No.: NSL-014
Reply to Office Action of November 18, 2005

AMENDMENTS TO THE CLAIMS

Kindly amend claims 12 through 14, 18, 20, 25 and 28 through 30 and add new claims 31 through 35 as shown in the listing of claims below. This listing of claims will replace all prior versions, and listings of claims in the application.

- 1 1-11. (canceled)
- 1 12. (currently amended) An inorganic/organic ~~hybrid~~ nanolaminate barrier film, comprising:
2 a plurality of layers of an inorganic material; and
3 a plurality of layers each consisting of an organic polymer material wherein the layers of
4 organic polymer material alternate with the layers of inorganic material;
5 wherein adjacent layers of the organic polymer material and inorganic material are
6 covalently bonded to ~~each other~~ layers characterized by covalent bonds that couple
7 adjacent layers together.
- 1 13. (currently amended) The barrier film of claim 12 wherein the total number of layers of
2 organic polymer material and layers of inorganic material ~~layers~~ in the film is between
3 about 100 and about 1000 layers, or between about 1000 and about 10,000 layers, or
4 between about 10,000 layers and about 100,000 layers.
- 1 14. (original) The barrier film of claim 12 wherein each of the layers of inorganic material has a
2 thickness of about 0.1 nm to about 1 nm; about 1 to about 10 nm; or about 1 nm to about
3 100 nm.
- 1 15. (original) The barrier film of claim 14 wherein the barrier film is substantially transparent.
- 1 16. (original) The barrier film of claim 12 wherein the barrier film has a permeability to oxygen
2 less than about 1 cc/m²/day, 0.1 cc/m²/day, 0.01 cc/m²/day, 10⁻³ cc/m²/day, 10⁻⁴
3 cc/m²/day, 10⁻⁵ cc/m²/day, or 10⁻⁶ cc/m²/day.
- 1 17. (original) The barrier film of claim 16 wherein the barrier film has a permeability to water
2 vapor less than about 1 g/m²/day, 0.1 g/m²/day, 0.01 g/m²/day, 10⁻³ g/m²/day, 10⁻⁴
3 g/m²/day, 10⁻⁵ g/m²/day, or 10⁻⁶ g/m²/day.

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1 18. (currently amended) The barrier film of claim 12 wherein one or more of the layers of
2 organic polymer material~~layers~~ is a superhydrophobic layer.

1 19. (original) The barrier film of claim 18 wherein the superhydrophobic layer includes
2 fluororalkylsilane.

1 20. (currently amended) The barrier film of claim 12 wherein the layers of organic polymer
2 material~~layers~~ are made from polymer precursors to which one or more one or more
3 hydrophobic groups have been added.

1 21. (original) The barrier film of claim 20 wherein the one or more hydrophobic groups are
2 selected from the group of non-polar hydrophobic groups, methyl groups, benzyl
3 (aromatic) groups, PO_4^{3-} , SO_4^{2-} , CH_3COO^- , Cl^- , Br^- , NO^- , ClO_4^- , I^- , SC_n^- anions, NH_4^+ ,
4 Rb^+ , K^+ , Na^+ , Cs^+ , Li^+ , Mg^{2+} , Ca^{2+} , Ba^{2+} cations, tryptophan, isoleucine, phenylalanine,
5 tyrosine, leucine, valine, methionine, and alanine.

1 22. (original) The barrier film of claim 12 wherein the barrier film is made from a sol including
2 one or more Gemini surfactants.

1 23. (original) An article of manufacture, comprising:
2 an object having a surface; and
3 an inorganic/organic hybrid nanolaminate barrier film of the type set forth in claim 12
4 disposed on the surface.

1 24. (original) The article of manufacture of claim 23 wherein the object is selected from the
2 group of optoelectronic devices, LEDs, solar cells, FETs, lasers, pharmaceutical products,
3 tablets in packages, medical devices, food products, packaged foods, beverages, candies,
4 display screens, touch panel displays, flat panel displays, electroluminescent windows,
5 windows, transparent films and coatings, electronic components, and chassis for appliances
6 used in rugged environments.

1 25. (previously presented) The barrier film of claim 12 wherein one or more of the layers of
2 organic and/or inorganic materials are in the form of lamellae.

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1 26. (currently amended) The barrier film of claim 12 wherein one or more of the layers ~~of~~ of
2 organic and/or inorganic materials are in the form of tubules.

1 27. (previously presented) The barrier film of claim 12 wherein the organic polymer material is
2 chosen from the group of polyethylene naphthalate, polyether etherketone, polyether sulfone,
3 polymers formed from fluorinated or non-fluorinated styrene polymer precursors, fluorinated
4 or non-fluorinated methyl styrene polymer precursors, fluorinated or non-fluorinated
5 (meth)acrylate polymer precursors, and combinations and/or derivatives of two or more of
6 these precursors.

1 28. (previously presented) The barrier film of claim 12 wherein adjacent layers of the organic
2 polymer material and inorganic material are covalently bonded to each other at an interface
3 between organic and inorganic materials.

1 29. (currently amended) The barrier film of claim 12 wherein the layers of the organic polymer
2 material are discrete layers ~~and wherein the layers~~ of organic polymer material and wherein
3 the layers of inorganic material are discrete layers of inorganic material.

1 30. (previously presented) The barrier film of claim 12 wherein alternating layers of organic
2 polymer material and inorganic material present a long and tortuous penetration path through
3 the barrier film to an underlying substrate.

1 31. (new) The barrier film of claim 12 wherein layers of the inorganic material are self-
2 assembled layers of inorganic material.

1 32. (new) The barrier film of claim 12 wherein layers of the organic polymer material are self-
2 assembled layers of organic polymer material.

1 33. (new) The barrier film of claim 12 wherein at least one coating of material self-assembles
2 into the alternating plurality of layers of inorganic material and plurality of layers of organic
3 polymer material.

1 34. (new) The barrier film of claim 12 wherein layers consisting of the organic polymer material
2 and layers of the inorganic material have different material compositions.

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- 1 35. (new) The barrier film of claim 12 wherein the layers of inorganic material are layers
- 2 consisting of the inorganic material.